SLEEP DISORDERS

Dr. Michael Twery

DR. TWERY: I am delighted to have been invited here today to talk with you a little bit about sleep. We are going to focus a lot on sleep, a little bit on sleepiness, and then in the end a little bit on sleep disorders.

There are about 70 different sleep disorders in the United States, and you are going to find out that this is actually quite a big problem. I am sure for many of you, the reason you are here is because you may have a problem with sleep or you know someone who has a sleep disorder.

So sleep disorders—that is the first point that I would like to raise. Sleep disorders are estimated to affect 20 to 30 million Americans, and those are people who actually have a sleep disorder. But many people have perhaps only a sleep problem from time to time, and if you add those to the total, it is thought that the number of people affected by sleep problems may reach up to 70 million people each year.

In comparison, sleep is of the same magnitude or greater of common disorders that you may be familiar with, such as asthma, COPD, high blood pressure, congestive heart failure, and diabetes.

An interesting question: Do you love sleep? We are going to have a little test. I do not want you to get the wrong idea. That is why we have left the lights up very high. But why don't you close your eyes for a second and think about this. Okay. You love sleep.

Now I know this is a very tough exam. Right? It is a yes or no answer. And I will be quiet for just like five seconds. So can you just close your eyes and think about this. You know, relish the thought of sleeping. I do not want to lose you.

So how many of you would say yes? We love sleep, don't we?

Well, one of the interesting characteristics about sleep, one of its fundamental qualities is that when you are sleeping you are unaware of being asleep. And it is this absence of consciousness which is the most important fundamental and recognizable property of sleep. When you are asleep, you are unconscious of the fact, and it is not something that you can digest.

So I pose the question to you. Can you love—can you have a love affair with something that you cannot experience?

So when are we sleeping? And this is a question, and we can hook you up to all kinds of medical machines and take measurements, but scientists for a long time have recognized that we are sleeping when waking consciousness is absent, and there is reduced movement. It seems like a relatively simple fundamental quality but that is what sleep is about. That is what differs us from wakefulness.

What is the difference between you when you are awake versus when you are asleep? It is the absence of waking consciousness.

Even though you are sleeping and you are not aware of this conscious—and you are unconscious of what is going on around you, you have reduced awareness of your environment—sleep does not mean that the brain has shut down or turned off. Rather, scientists have learned that the sleeping brain is working as hard as the awake brain.

And this picture right here is a picture taken from a research study showing activity in different brain regions during sleep.

Rest does not equal sleep. Many of us think that when we lay down to rest we are going to be sleeping. There is a very old study where Professor Nathaniel Kleitman (phonetic) at the University of Chicago asked volunteers to go to bed as they did every night but not to sleep. And in these studies it was clear almost immediately that if individuals succeeded in avoiding sleep while resting in bed all night, they still felt sleepy the next day. In other words, they were anything but rested. Resting in bed but not sleeping for two consecutive nights in this study was impossible. Rest does not equal sleep.

Sleep is also a compelling need that cannot be avoided because without sufficient sleep the desire to sleep quickly becomes more important than life itself. And all mammal species sleep, birds also sleep. Scientists are unsure about reptiles, fish, insects, and other life forms, which may not sleep but they do rest.

Pervasive sleepiness in America. This is really a major problem. In early July 1999 near Stanford University a promising high school graduate fell asleep at the wheel of her car, and she and one of her friend were killed and several others in that accident were injured. I think probably everyone in this room over the course of the last year has seen similar stories in the newspaper. One that you might have seen in Texas in the last year, a Texas University student who fell asleep at the wheel, swerved into the sidewalk and killed six of his fellow students. Drowsy driving and problems of sleepiness of society are

a very serious medical problem.

Other examples: Sleep deprivation has contributed to events such as the 1986 Challenger explosion, the Exxon Valdese grounding, and the near meltdown of Three-Mile Island.

So why do we need to sleep? Why is it important? And if we look at the explanations that were in circulation back about 1950, it was thought that there was the common sense explanation that sleep results from a reduced brain activity due to fatigue. And scientists thought that sensory stimulation was needed to keep us awake and that when you removed the sensory input—when we stopped doing things and when we stopped receiving signals, such as I am talking to you now but if I were to stop talking to you, you would lose that sensory input—when the sensory input decreased, the brain would fall asleep.

But the function of sleep is not to prevent sleepiness any more than the function of eating is to prevent hunger. Sleep is a physiological process. It affects practically all parts of your body and sleep cannot be removed as can an organ to find out how it contributes to our health.

Today, nearly 50 years later, we have some ideas about why we need to sleep and what its function is. Today we are thinking in terms of restoration and recovery. But a question that persists is we do not know what is restored or what is recovered. Energy conservation. When we are sleeping, perhaps we are conserving our energy. Something like hibernation perhaps. But at least for man, the same amount of energy is conserved just by resting and not sleeping.

Needless to say that with this huge gap in our understanding about why we need to sleep, there are many other functions that have been proposed. Things like how does sleep contribute to brain growth. How does it contribute to our memory function, discharge of emotions? And there are many, many other ideas relating to sleep and why we need it.

This abundance of theory suggests that sleep may have many functions or perhaps a single common function that runs through all these other physiological processes that have not yet been identified. Sleep researchers are investigating how sleep is regulated and why it is necessary for the maintenance of good health.

So in the upper left-hand corner, this is one of the experiments that our scientists

are doing to look at how sleep is regulated. Up in the corner here we have a hamster. A hamster? Yes. Running in a running wheel, and they follow the activity of this animal throughout its day to find out when it is sleeping and when it is active.

And this graph on the right-hand side shows the results of one of these experiments and each line across represents a separate day, and each black bar represents the times when that animal was in his running wheel and active. The yellow area is the time when the light is on in the room.

So you can see the experiment starts here, and during the daytime the hamsters generally sleep and then, when the lights are turned off, they begin to run in the running wheel. And the next day they do the same thing and the next day the same, and so forth.

When they change the experiment and they don't turn on the lights in this experiment the animals still start to run in the wheel at the same time one day, and the next day, and the next day. In other words, when you place this animal in his cage space, even if it lacks the cycle of light and dark, which we think gives him the clue as to when to start running, they continue to run approximately every 24 hours.

It was this observation that suggested to scientists that an internal timekeeping mechanism tells the hamster when it is time to start running; that mechanism is referred to as the biological clock, and this clock and the brain is largely responsible for the timing of cyclic behavior such as sleep.

This is a cross-section of the human brain, and the biological clock is in a tissue region that is located in the lower part of the basal area of the human brain under the hypothalamus.

The length of this biological clock cycle varies between organisms, and in man, scientists have found that this clock cycle is about 25 hours. In 1953, again Dr. Nathaniel Kleitman discovered that sleep was not a single process but that there were two distinct different kinds of sleep. One is rapid eye movement sleep and then nonrapid eye movement sleep or non-REM sleep, and that these phases, the REM sleep and the non-REM sleep, alternate in a cyclic pattern throughout the night.

And this chart right here is referred to as a hypnogram, and what is plotted on this graph is wakefulness represented by the top of the graph and deeper sleep closer to the bottom of the graph, and this line plots the depth of sleep over the course of night in a

human subject.

And you can see that we go from very deep sleep and then to REM sleep, which is very close to—where the brain is very active similar to wakefulness, and then back to deep sleep, and back up and down throughout the night.

Rapid eye movement sleep is characterized, of course, by the rapid eye movements, and it is interesting that that is actually how that form of sleep was originally perceived. The researchers sat with subjects and observed the movement of their eyes all through the night. It was an exhausting experiment for the researcher, but that was their earliest way of measuring rapid eye movement.

But, also, REM sleep is associated with vivid dreaming and sleep paralysis. It is one of the unique qualities of REM sleep that when you are in this stage of sleep, you lose the ability to move all your voluntary muscles. The only muscles that continue on is your breathing muscles and the eye muscles.

Brain wave pattern during REM sleep closely resembles that of wakefulness, and because of that, REM sleep has also been sometimes referred to as paradoxical sleep. If we connect you to an electroencephalogram, the wires that would be attached to your skull and record the electrical activity of the brain, it would look very much like wakefulness during REM sleep.

On average, the REM sleep and the non-REM sleep phases alternate with one another about every 90 minutes throughout the night.

Now this is an interesting point that I would like to use to introduce the next part of this talk where we start to look more about sleep problems and sleep disorders. Many of you may be feeling as we get older, every year it gets harder and harder to wake up, and so it means we need a little bit more coffee in the morning. Fortunately, at a meeting like this, I think that the coffee cups are bottomless so feel free to continue.

So imagine a medical condition of epidemic proportion causing a long period of disability. Only three to five percent of the people suffering from this condition are diagnosed and the other 95 to 97 percent do not even know they have this condition. The symptoms can be completely eliminated by a treatment that costs about the same as a desktop computer. If you knew all this, what would you do?

Well, Congress responded by establishing a congressional commission in 1993, to study the role of sleep and sleep disorders in American society. The commission was also to specify problem areas and recommend solutions. There were two years of investigation and hearing testimony about sleep disorders from physicians, family members, accident victims and sleep experts, and this commission produced a report called *Wake Up America: A National Sleep Alert.*

What the commission concluded, its two major findings, was that sleep deprivation is pervasive and results in enormous costs in lives and dollars across the United States, and that there are epidemic numbers of undiagnosed and untreated or misdiagnosed and mistreated sleep disorder cases. These were the two conclusions that the commission thought were the most pressing problems.

The commission generated a number of recommendations, and Congress has acted on those recommendations. In 1993 it established by a legislative mandate to the NIH, a National Center on Sleep Disorders Research, and this is the office in which I am currently acting director. The purpose of this office is to coordinate within the National Heart, Lung, and Blood Institute and across the NIH and other government supported agencies the sleep research, training, and education activities.

This legislation also established a National Sleep Disorders Research Advisory Board, which advises the director of the NIH and the director of the National Heart, Lung, and Blood Institute, as well as other offices within the NIH, about directions and needs for sleep disorders medicine and research.

We have also prepared an NIH Director's National Sleep Disorders Research Plan. The national center has a Web page and the Web site is listed here. It is basically under the NHLBI home page.

We have bookmarks on the handout table, with the Web address, and it will be convenient for you to pick up if you would like to go to the Web site. This site has all of our publications and information, much of what you will hear in a few moments.

So …

(Dr. Twery starts a recording of snoring.)

So a few moments ago I had a slide that was titled "Imagine this." Well, this is the

disorder, the sleep disorder that I was referring to in that slide. I was talking about sleep apnea. Sleep apnea is a condition where there is a temporary, momentary interruption in the airway or there is a cessation of effort to breathe, but most commonly the airway is obstructed preventing breathing.

And the most commonly recognized symptoms for sleep apnea are the snoring, daytime sleepiness, and breathing pauses that are recognized. And sleep apnea is common. If you recall, it may affect four to six percent of Americans, but in the elderly sleep apnea is much more common than that.

I know that there are some people in the audience who specifically asked me about sleep problems in children, whether I was going to talk about that, and that is not going to be a major focus, but I do have a sound clip that bears on the issue of sleep disorder and breathing problems in children. I would like to play just a few moments of that.

(Dr. Twery starts a recording.)

"ANNOUNCER:" "This is HealthBeat."

"DR. McLAUGHLIN:" "It is often in the older child a very loud snoring. Sometimes very frightening to the family to hear this."

"ANNOUNCER:" "Dr. Gerald McLaughlin of the Johns Hopkins University School of Medicine says loud snoring in a child can be a symptom of sleep apnea, a sleep disorder that prevents a person from getting enough oxygen during sleep. Dr. McLaughlin says in children the snoring is both loud and persistent."

"DR. McLAUGHLIN:" "It is also very often marked by these periods of silence, which reflect total airway obstruction as the airway is completely collapsed. The second thing that the parents often notice is restless or disturbed sleep patterns, kind of tossing and turning, and the bed covers are tossed aside and then the child can be found sleeping in all sorts of unusual positions."

"ANNOUNCER:" "Children with sleep apnea may seem sluggish and perform poorly in school because they are unable to get a good night's sleep. Parents who suspect the presence of sleep apnea should talk to their child's doctor."

DR. TWERY: Okay. So sleep apnea is when you stop breathing, and what

are the consequences of that? It is a potentially serious sleep disorder problem, and when you stop breathing, one of the things that happens is that you become hypoxic. You have insufficient oxygen. Another thing that happens is your mind says, 'Hey, wake up, you have got to do something here. You are not breathing.'

Well, people with sleep apnea, children or adults, they may not come all the way back to consciousness and be aware of the breathing pause. The presence of the breathing pause does bring them up out of sleep, and instead of having the normal rhythm, the normal sleep architecture, they have rather a disturbed and broken sleep architecture, and as you heard a moment ago from Dr. McLaughlin, they are unable to get refreshing sleep.

Another thing that happens is when you stop breathing your blood chemistry becomes out of balance and there is a build-up of carbon dioxide; the scientific term for that is hyperkalemia.

The implication is not just in your airway or in your lungs but there also are effects of these disturbances on other parts of your brain where you need to have a steady flow of oxygen and also on your heart and other tissues. If you hold your breath, for instance, you may feel your heart begin to race. And this happens, and people with sleep apnea may stop breathing hundreds of times a night.

We think that the lack of oxygen and these chemical imbalances and the neurological processes represented by the brain crying for help, so to speak, leads to a lot of different changes, pathological changes contributing to other diseases.

[Sleep apnea] is now being looked at in terms of possibly contributing to neurodegenerative disorders and affecting the function of heart muscle, for instance contributing to heart failure. It is very common in people with heart failure to have an abnormal rhythmic breathing very similar to sleep apnea.

Another area where the Heart, Lung and Blood Institute is currently doing research is called "The Sleep Heart Health Study," and it looks at the association of sleep apnea with hypertension and cardiovascular disease. These are the results of the first five years of the study. We plot here the risk of hypertension against the severity of sleep apnea.

This shows that even minimal sleep apnea severity, a level of sleep apnea that would be just barely detectable in a sleep clinic, produces about a 10 percent increased risk of hypertension. But as you increase the severity of sleep apnea, the risk of associated

hypertension increases to 37 percent or greater. And this effect is independent of other body factors such as whether the person smokes or whether the person is overweight. This increased risk is associated with sleep apnea severity.

The National Commission report went on to estimate that there may be as many as 38,000 deaths each year due to the cardiovascular consequences of sleep apnea.

Now another disorder that I would like to bring to your attention is narcolepsy, because narcolepsy is not a rare disease. Many of you think of narcolepsy as an individual who will collapse onto the floor and that is actually very uncommon. Instead, narcolepsy is a relatively common disorder. It is the second leading cause of excessive daytime sleepiness after sleep apnea in terms of sleep disorders. Narcolepsy is important also because it is a very disabling illness and it affects the individuals, their work, their leisure, and their interpersonal relations, and because of their excessive daytime sleepiness, there is an increased likelihood of accidents.

(Dr. Twery starts a recording.)

"MR. PISCOPAL:" "I slept through most of my college classes and by that time I had already had eight automobile accidents, but I really did not have a guess as to whether it was a medical condition or not."

"ANNOUNCER:" "For 50-year-old Joe Piscopal it was a medical condition. Narcolepsy. A disabling sleep disorder that causes sufferers to fall asleep suddenly in inappropriate or even dangerous situations."

"MR. PISCOPAL:" "I had 15 automobile accidents between the time I was 16 and 24."

DR. TWERY: So to summarize the narcolepsy symptoms: excessive daytime sleepiness, abnormal sleep patterns, sleep paralysis, dream-like hallucinations, and in the worst and most extreme cases cataplexy, and that is the sudden episode of muscle weakness, often triggered by strong emotions such as laughing, surprise or anger.

Now for narcoleptics, diagnosis is the key. It is important to bring this to the attention of the physician. Detection of narcolepsy seems to be the gap for these patients because studies have found that the mean number of years between the onset of symptoms and correct diagnosis is about 14 years. Often narcolepsy has its onset in adolescence, and

a person may be in their 30s before it is finally diagnosed correctly.

Symptoms of narcolepsy appear during adolescence. Narcoleptic patients may be diagnosed too late to prevent the impact of disease on their personal and professional development.

Now I am not going to read through this page, but I just wanted to highlight that there have been many new advances in narcolepsy research in the last year, and this is probably one of the most exciting areas of research—not only for sleep but also for the whole approach of understanding a disease based on the genes that it affects, because with narcolepsy researchers have been fortunate to have animal models, such as dogs, where spontaneous cases of narcolepsy occur, and by studying these animals and their genes it was possible to identify the particular gene that was linked to their narcoleptic symptoms.

Very recently, researchers have been able to demonstrate in humans with narcolepsy that there appears to be an inadequate amount of the product of that gene present, and that this is likely to be the cause of human narcolepsy.

The discovery is important not only because it links a gene to the disease but because that understanding is going to pave the way to improved understanding of the fundamental nature of sleep and this pathway linked to a disorder producing excessive sleepiness.

Another disorder …

(Dr. Twery starts a recording.)

"MR. BALKAM:" "I was awakened by a crawling sensation deep within my legs. It made me move my legs to get relief but I got no relief while in bed."

"ANNOUNCER:" "74-year-old Robert Balkam has restless leg syndrome."

DR. TWERY: Restless leg syndrome. Again a relatively common sleep disorder in this country. It may not selectively affect you during sleep but it is also going to affect you during the day. The characteristics of RLS or restless leg is that the symptoms appear to be worse at night. Unpleasant sensations in the legs, described as creeping, crawling, tingling, pulling or pain.

One or both legs may be affected, and for some people arms are affected. Sensations occur during periods of inactivity such as laying down, sitting, or watching a movie. And RLS symptoms tend to follow a daily cycle. That is a key feature. They follow a cycle in which in the evening and during sleep it appears to be worse than during morning hours and during the day time.

Insomnia.

(Dr. Twery starts a recording.)

"MS. SPENCE:" "You become more nervous. You lose your temper much more quickly. You cannot think straight. You do not come up with words."

"ANNOUNCER:" "Hannah Spence is among the millions of Americans who have insomnia."

DR. TWERY: So for insomnia, I am sure many of you have probably felt that you have had this condition. Insomnia is associated with difficulty falling asleep, frequent waking during the night, and difficulty returning to sleep, waking too early in the morning and unrefreshing sleep.

(Dr. Twery starts a recording.)

"ANNOUNCER:" "If you have ever been so sleepy you have to struggle to stay awake while reading, watching TV, or even driving, Dr. David Dinges of the University of Pennsylvania says you may have problem sleepiness."

DR. TWERY: Sorry about that.

(Recording.)

"ANNOUNCER:" "If you have ever been so sleepy—"

DR. TWERY: Technology. We have these other sleep disorders but it is chronic sleep loss and sleep disorders that are so pervasive in our society that sleepy behavior is now almost a normal behavior, and I am sure if we just take a moment to think about our work place or our home, this is probably the case.

If you come to your workplace or you see someone who looks sleepy, what is your first thought? Well, you may think that they are lazy but it could also be associated with either inadequate sleep or an actual sleep problem. And have we considered that possibility? Sleep debt and its consequences may be the number one sleep problem in America.

Signs of sleep debt associated with problem sleepiness are drowsiness and fatigue in the early afternoon, difficulty getting up in the morning, sluggish and poor motivation.

Again these are things that you probably either experienced yourself or have seen in others, and this points to the idea that I would like you to take home—the idea that this is a very pervasive problem across the United States.

The elderly are a very special question for sleep disorders since they may be more susceptible. Half of elderly Americans complain of chronic sleep problems and as a result, up to 40 percent of sleeping pill prescriptions go to the elderly.

Sleep problems in the elderly include less daily sleep, frequent and longer awakenings during the night, a shift in sleep pattern to sleep earlier and get up earlier, and more and longer daytime naps.

Now many of us have probably heard of melatonin and understanding how sleep is regulated should allow the development of "natural" sleeping pills and, indeed, melatonin is a natural substance. However, no substance, as yet, has been widely accepted among scientists as being a driving force for sleep.

Melatonin does have the effect, however, of resetting the biological clock so that when you are experiencing jet lag or if you are shifting the time that you are awake, this ability to reset the biological clock may help to adjust for some sleep abnormalities. It may help some of these people go to sleep on a more regular basis. But whether melatonin induces sleep is still unclear and more research is needed to make that determination.

Melatonin may help the elderly in particular because there have been populations of elderly found where the levels of melatonin are inadequate, and giving melatonin to these people may be helpful in some cases.

We have talked about a couple different types of sleep problems and what I would

like to do is highlight these. We have talked about insomnia, which is probably the most prevalent sleep problem across the United States at 15 to 30 percent of the population. Restless leg syndrome has been estimated between 5 and 15 percent of the population. Sleep apnea, two to four percent. Narcolepsy, less than 0.1 percent. And sudden infant death, another sleep-breathing problem usually occurring during sleep, is a smaller percentage but a very tragic one.

So at this point, I would like to just mention a few words on how to find help for sleep disorder patients. The people that you know who may have problems with sleep. People with sleep disorders have a history of having been to several doctors usually who are unable to diagnose their condition.

As patients, as interested individuals, you need to be a little bit persistent because if you look at the surveys that have been done of medical school education over the last ten years, you would find that physicians do not routinely receive appreciable training in any area of sleep disorder medicine. That is something that the Heart, Lung and Blood Institute is working to change. We have launched a program called the Sleep Academic Award in which we have researchers at 20 medical schools who are developing new educational resources for physicians specifically on sleep disorder medicine.

But for now, you may find that it is difficult to find doctors who are prepared to diagnose and treat sleep conditions. [Patients suffering from sleep disorders] may have been labeled as suffering from depression, or even hypochondria, and this is part of the tragedy and the delay. Getting a proper diagnosis is needed—proper diagnosis is key to obtaining appropriate treatment and control of symptoms.

So because sleep disorders sufferers frequently look healthy, I think that you and your family members have to be careful not to see fatigue as necessarily equivalent to laziness. This is an interesting question.

One of the problems is communication with your doctor. If you polled people and asked how they would describe sleepiness to their doctor, the number one answer would be, "Lack of energy." Sixty-two percent of people describe their problem as "lack of energy." The number two answer, "Tiredness." Sixty-one percent would describe the reason they are coming to their doctor as "tiredness." "Fatigue." Fifty-seven percent would characterize it as possibly fatigue. "Sleepiness," 47 percent.

Now while these numbers are perhaps not terribly dramatic differences, I think

what it does point out is that it is necessary to provide your physicians with the proper information and that—as I hope one of the things you are going to take away from today—our little chat today is that all of these feelings may be related to sleepiness. Is it sleepiness? Because we are so accustomed to be sleepy. It is normal, so we do not necessarily see it as sleepiness. Perhaps fumbling or fatigue. Is the underlying cause that we are not getting enough sleep?

Now you can find more information about sleep disorders at the National Center on Sleep Disorders Research Web page, which I provided the Web address for you. And here we have Sleep Disorder factsheets, some of which you can obtain out at our booth across the hall. We also have public service announcements. You can hear the sound clips and these can be accessed over the Web.

The Sleep Center will also launch a new program on educating youth about sleepiness and sleep disorders. And one that is just getting underway is a collaboration—a partnership with Garfield, and Garfield will be working with our youth program to educate youth. There is currently a contest. If you go to the Garfield Web site, www.garfield.com, children in grades one to five can sign up for a cartoon contest on the Garfield Web site on sleep and win a trip here to Washington to appear with Garfield and also receive some awards.

We also are focusing, as I mentioned a moment ago, on physician education.

There are many other organizations that you can turn to in terms of patient support organizations. There is the American Sleep Apnea Association (which is headquartered here in the Washington area), the Narcolepsy Network, the Restless Legs Foundation, and the National Sleep Foundation. The National Sleep Foundation is also headquartered here in the Washington area.

There are professional organizations. The American Academy of Sleep Medicine. This is the organization that accredits sleep centers and gives them certification accreditation that they have practicing or prepared to practice sleep disorder medicine. The American Board of Sleep Medicine. This is the organization that accredits individual physicians as to their capability to conduct sleep disorder medicine. And there is also the American Thoracic Society. With the Thoracic Society, we are thinking here in terms of pulmonologists because sleep apnea is a very common breathing problem. Pulmonologists for many years have been trained to treat many sleep disorders, including sleep apnea, and they are a member of the American Thoracic Society.

What I would like to leave you with is a message that sleep is vitally necessary for health and survival, and if you have symptoms of sleep problems, please seek advice from your physician or your sleep specialist.

That concludes my prepared presentation, and I will be happy to take questions. I think we still have some time.

(Inaudible—Someone not at a microphone asks a question).

DR. TWERY: You know this is an interesting question. I cannot explain 20 years of time but I can give you some idea of what happens on a daily basis. Let's say we go to work during the week. Most everyone in the room looks like we are old enough to go to work. And, you know, you go to work for seven, eight hours and then you come home and you have to feed the kids, and so maybe you run a sleep debt every day. You are not getting enough sleep. By the time you come to the weekend if you are lucky, if your kids do not have to go to practice or football or something, then you will have what is called rebound sleep. And you may try to sleep—your body may try to let you sleep longer during these periods when you let yourself do so.

But the problem there is that you can only rebound a certain amount each day. You can only reclaim a certain catch-up a little bit each day. So it may take several days of recovery to get back to your fully rested condition and so forth. On average, adults need about eight hours of sleep a day. And the need for sleep changes through time. The problem is that our ability to sleep alters.

At birth there is a tremendous need for sleep. Infants will sleep maybe 12 to 18 hours a day, but that sleep occurs all through the day. And it is because their biological clock has not yet matured and it is not tied to the settings of day and night, but as you watch the infant develop, within three months or three to four months usually, they begin to synchronize. Their sleep patterns begin to synchronize with day and night.

And then you move to adolescence. Adolescents need eight to nine hours of sleep a night. The problem with adolescents is that their biological clock is shifting relative to middle age adults and the elderly. During their teenage years, adolescents' biological clocks are such that they want to get up later and they will go to sleep later. Their biological clocks are shifted later into the night, so this is a natural pattern.

I know many of us if we think back, you know, our parents were always ready to

go to bed before we were as teenagers and that is actually the case. There is a biological basis for that. And this is also the basis for the discussions that you probably heard in the radio and other panels around the country about later school start times for teenagers. It is because their biological clocks on average, and it is not saying that every one—every single person is identical but on average their biological clocks, their drive for wakefulness becomes strong at a later time in the morning. It is a couple of hours.

(Inaudible—Someone not at a microphone asks a question).

DR. TWERY: Well, there are probably ways to train ourselves. One could go to sleep earlier and just follow a pattern and then you might be able to get up earlier.

(Inaudible—Someone not at a microphone asks a question).

DR. TWERY: Melatonin is part of the driving force. So the sleepiness and wakefulness—right now the big picture, the way that it is thought that this is regulated is that the biological clock, the activity of the clock, the output of that brain area where the clock resides is thought to drive wakefulness. Whereas, as we are awake during the day, there is a build up of sleep-inducing neurotransmitters and these drive sleepiness but we have a lot of individual control about this.

I mean, clearly if you want to be awake and there is a fire, you will wake up and have no problem being wide awake. We do not understand how that part of the circuitry works, how that interaction works. You could train yourself to follow a pattern.

(Inaudible—Someone not at a microphone asks a question).

DR. TWERY: There are many drugs that can help facilitate sleep and also facilitate wakefulness. I am not a physician so I cannot make comments. NIH supports very little specific research on these drugs. There is a lot of work that has been done by the pharmaceutical companies and a great deal of work has been done in terms of understanding how these drugs interact with the sleep-regulating circuitry. But I think that as with any drug it is best not to have to use it if you can. For some people, whether they are going through mental stress periods or they may have an actual sleep disorder condition, it may be appropriate to use it, and that is where the physician comes in and their recommendation.

(Inaudible—Someone not at a microphone asks a question).

DR. TWERY: Insomnia. So this is an area which we do not understand. The research is still catching up with our needs, our growing recognition of what are the abnormalities that affect the duration of sleep, and what are the abnormalities that affect the initiation of sleep. But it could be something to discuss with your physician because it could be that you have a condition known as—I am not going to get this right but—a circadian disorder that affects the phase of your sleep. So your interactions with family and your routine activities keep you up late at night, but if you have one of these circadian phase disorders, your biological clock may be telling you to get up at 3:00 in the morning or 4:00 in the morning.

(Inaudible—Someone not at a microphone asks a question).

DR. TWERY: Actually there is research that is getting under way from the Alcohol Institute to look at the relationship between sleep loss and the use of alcohol. Alcohol and many other substances will help induce sleep, but the problem with using alcohol in that way is that there is a tremendous rebound problem. It does not produce the same quality of sleep, so this is not an avenue that we are looking at in terms of treatment or therapy.

(Inaudible—Someone not at a microphone asks a question).

DR. TWERY: Well, activity during the day itself is not related to producing sleep but if you follow a daily pattern, it may help and train your biological clock. Exercise—if you are taking walks at certain times or following a daily regular schedule to your activities, it may be such that it would help you in a sleep pattern, going to sleep at a particular time. But strong exercise just before sleep would not be helpful for most people.

(Inaudible—Someone not at a microphone asks a question).

DR. TWERY: Well, following a regular pattern. A regular pattern will help you —

(End Tape, Side A.)

DR. TWERY:—you know, people all with the same schedule.

(Inaudible—Someone not at a microphone asks a question).

DR. TWERY: Yes, that is an interesting point—we probably all have that feeling. I know I went to Italy and at 2:00 in the afternoon, you know, I was ready to go shopping and everyone was asleep. The stores were all closed. It was very frustrating. And then I had to take the train off to some place and I missed the whole thing.

There is an effect of the food that you eat because some of this food may have sleep inducing substances but it is also related to your biological clock because there is a dip—there is a cycle where wakefulness is strong, and the drive to wakefulness is strongest in the morning, and then there is a dip about 1:00 or 2:00 in the afternoon, and then another surge in wakefulness as we go into the evening, and then we have our regular night sleep phase.

So this time that you are talking about is a time when our drive for wakefulness is normally lower, and people have actually looked at the number of drowsy driving accidents as they occur across time, across the day, and it turns out that there is a significant bump right there in that after-lunch period and it is the same time that our circadian drive for wakefulness is lower.

(Inaudible—Someone not at a microphone asks a question).

DR. TWERY: This is a very good question. I mentioned our sleep academic award program. That group is getting together a meeting this summer, and they are going to begin discussing some work that they can do to do some research in this area.

You know, I think that the case can strongly be made that if you do not get adequate sleep that all kinds of judgment errors can result and physical errors, and there is an increased risk of accidents and so forth.

I think that our society is more complex than that. It does not just operate on data. We have economics. We have other forces. I mean, if you are talking about someone's fitness for duty, for instance, whether they can practice.

(Inaudible—Someone not at a microphone asks a question).

DR. TWERY: I think that this is something that physicians—particularly the sleep medicine community—are putting together some programs to address and it will be interesting to follow.

(Inaudible—Someone not at a microphone asks a question).

DR. TWERY: Well, that is one of the problems. So we need more research in all these areas. In the case of restless leg syndrome, you can use some medications that are similar to those used in Parkinson's disease, for instance, but there is a balance. There is a trade-off. Are your symptoms severe enough? And you may want to seek the advice of other physicians and get an opinion or go to a sleep medicine clinic and get a consultation there and see if they have a different approach.

(Inaudible—Someone not at a microphone asks a question).

DR. TWERY: Well, there is the class of drugs that are used in Parkinson's. They are used for controlling motor disorders. And those are sometimes used in restless leg syndrome.

(Inaudible—Someone not at a microphone asks a question).

DR. TWERY: The question is, does the biology change for shift work? Does our time, our clock change? Is that the question?

(Inaudible response).

DR. TWERY: Yes. The biological clock is not going to turn 180 degrees unless we change the way our day and night are cued. So usually for shift workers they spend a certain number of hours, you know, in one cycle, and then they will maybe switch to another shift.

(Inaudible—Someone not at a microphone asks a question).

DR. TWERY: Yes. But the problem is that during the day time what do you do?

(Inaudible—Someone not at a microphone asks a question).

DR. TWERY: Well, you sleep. But for a lot of shift workers, they do not sleep and they do not have that pattern of sleeping.

(Inaudible—Someone not at a microphone asks a question).

DR. TWERY: Yes, and it changes. And so shift workers are particularly vulnerable to this problem of always catching up. It is a very serious problem. Many companies consult with sleep medicine specialists as to how to properly design their shift work. You know, the most well-known example is how the astronauts deal with shift work. You know, when you are an astronaut and you are flying in the space shuttle around the planet every 90 minutes or so, it is a real problem.

And what happens is for the astronauts, they start shifting the astronauts' sleep cycles about two weeks before the flight and they give them some melatonin, for instance, to help them reset their biological clock and things. And they try to use all this technology of shifting their times –- it is very sophisticated—so that they will be at optimal performance when they actually go into flight.

The same science has not been applied to shift workers everywhere, but for air traffic controllers and truck drivers, many of these industries are consulting with sleep medicine experts and getting that kind of help.

(Inaudible—Someone not at a microphone asks a question).

DR. TWERY: Sometimes when we go to sleep, we may be preoccupied with certain thoughts that could keep us awake. That is a form of insomnia. And there are a number of different tricks. There are also some medications that may help. Sometimes it is just a matter of breaking the cycle but this is something you should consult with your physician about, or find a sleep medicine specialist who can help you. The American Academy of Sleep Medicine and the American Board of Sleep Medicine provides a list of those people.

(Inaudible—Someone not at a microphone asks a question).

DR. TWERY: HMOs... I cannot really comment on any particular case. I know that you probably would need to be persistent in explaining in the field that this is a sleep problem and ask for a referral to a sleep medicine specialist.

(Inaudible—Someone not at a microphone asks a question).

DR. TWERY: We do not know. It is a motor movement disorder that occurs during sleep and people feel that they have a itchy feeling in their legs.

(Inaudible—Someone not at a microphone asks a question).

DR. TWERY: Tingling and movement helps it to feel better but we do not know what the cause is.

(Inaudible—Someone not at a microphone asks a question).

DR. TWERY: No, I do not, but my name and my contact information is on our Web site. There is a bookmark. Michael Twery. Michael Twery, T-w-e-r-y. Thank you.

(Inaudible—Someone not at a microphone asks a question).

DR. TWERY: Well, I do not have lists here, but the American Academy of Sleep Medicine will tell you where their sleep centers are, and the American Board of Sleep Medicine has accredited sleep physicians who specialize in sleep problems.

(Inaudible—Someone not at a microphone asks a question).

DR. TWERY: In epilepsy or which institute?

(Inaudible—Someone not at a microphone asks a question).

DR. TWERY: We do not do that any more.

(Inaudible—Someone not at a microphone asks a question).

DR. TWERY: It has been (inaudible). I do not think their biological clock (inaudible). It could be that their biological clocks are different (inaudible).

(Inaudible—Someone not at a microphone asks a question).

DR. TWERY: No, there is a seasonal variation, but it has more to do with the timing of day and night because we clue our time (inaudible) and also it is a little bit hard to tease out our environment. You know, we go home and turn on the lights and all this kind of stuff and in the old days it was dark and people just went to bed. (Inaudible) but now we spend our winter nights (inaudible).

(Inaudible—Someone not at a microphone asks a question).

DR. TWERY: Temperature. So what happens is actually a region of your brain that is involved with controlling (inaudible). When you feel warm, your core temperatures drop.

(Inaudible—Someone not at a microphone asks a question).

DR. TWERY: Okay. If you drink alcohol, you may feel a flush. That is because your blood vessels underneath your skin are dilating and you (inaudible) but you feel warm. And your core temperature—when your core temperature drops that is a part of (inaudible). So, I mean, cold feet is a little bit more complex (inaudible) circulation and a lot of other (inaudible). A drop in temperature, only a degree or two now, is sufficient to (inaudible). Actually there are some interesting experiments in rodents where they can take a temperature probe and if they just lower the temperature of that rodent by one degree the animal (inaudible).

(Inaudible—Someone not at a microphone asks a question).

DR. TWERY: Well, it is only one degree. I mean, it is just little tiny changes is all that is necessary.

(Inaudible—Someone not at a microphone asks a question).

DR. TWERY: I do not think so. What happen is, is you lower the temperature of the brain (inaudible) slows down. So it is the increased activity in the area that is responsible for waking you up (inaudible).

(Inaudible—Someone not at a microphone asks a question).

DR. TWERY: We do not know. We do not.

[Conversation has become inaudible.]

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